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(54) Method and apparatus for the post-process check of the workpieces in a double-plate lapping machine.

(57) A method and an apparatus for the post-process check of the workpieces machined by a double-plate lapping machine, in which the upper plate is associated to means controlling the lowering and the pressure applied on the workpieces, and the lower plate is provided with a probe able to detect the spacing from the upper plate and to feed a signal representing said spacing to an electronic meter, in which the corrected value F(K) obtained from the difference between the heights of the workpieces at the end of the first two machining cycle is set, said value being compared with the average of the values provided by a feeler pin detecting the thickness of four lapped workpieces located at diametrally opposed positions at the end of each machining cycle so as to provide a further correction signal considering the variable parameters from cycle to cycle, said correction signal being fed to the central data processing unit for the resetting thereof.

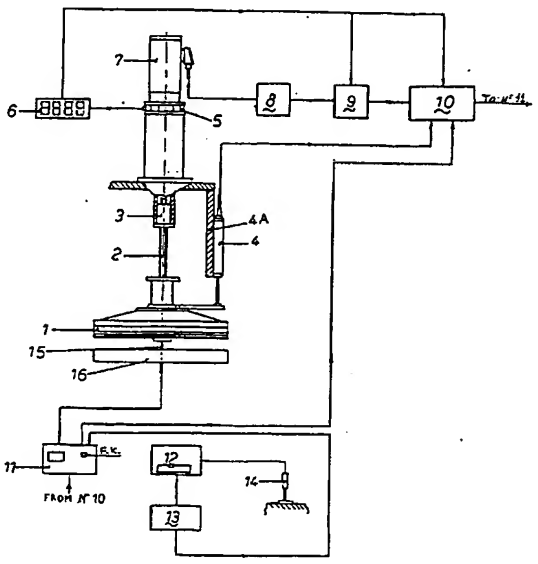

Fig. 1

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The present invention relates to a method and an apparatus for the post-process check of the workpieces in a double-plate lapping machine.

In the lapping machines of the mentioned type the check of the lapped workpieces is manually carried out by the operator who measures the heights of the workpieces at the end of two consecutive machining cycles. The difference in the heights measured in both cycles allows the wear of the two plates, i.e. the "k-factor", to be evaluated, such factor being used to manually reset an electronic meter connected to a feeler pin which is located at the centre of the plate for measuring the wear of the latter.

It should be noted that the wear of the plate actually depends on many machining parameters varying from cycle to cycle such as pressure of the upper plate, speed of rotation of such plate, chemical-physical characteristics of the used abrasive slurry, grinding allowance, a.s.o. K-factor cannot then be considered as a constant but should be corrected at any machining cycle.

This correction is presently carried out by measuring the heights of the finished workpieces located at diametrally opposed positions and by determining the difference of the average of such heights and the previously calculated K-factor in order to make a further correction.

This invention seeks to provide a method and an apparatus which allow the above mentioned problem to be semi-automatically overcome, thus avoiding any calculation by the operator at the end of any machining cycle.

According to the invention, in a double-plate lapping machine a method for the measurement and post-process check of the workpieces is provided consisting in operatively combining an automatic data processing unit driving the lowering of the upper plate and controlling the automatic system for the continuous adjustment of the pressure exerted by said upper plate (which is the object of a previous Patent Application of the same Applicant) with a feeler means able to measure the thickness of four workpieces located at simmetrically opposed positions at the end of any machining cycle, and a microprocessor providing the average of such measurements and controlling at the same time the spacing between the plates.

The spacing between the two plates measured by a probe is converted to a signal which is fed to an electronic meter in which K-factor is set, such signal being compared with the signal of the thickness measurement average provided as described above at the end of any machining cycle so as to reset the setting data of said processing unit.

As a result of the comparison of said two signals the upper plate is shifted according to the optimum adjustement of the lapping machine.

This invention will now be described with reference to the accompanying drawing showing the general diagram of the method and the apparatus.

With reference to the drawing the upper plate designated by 1 rotates about its axis and slides along said axis through the ball bearing screw 2 engaged in the lead nut 3. The latter is carried by the stationary frame 4A of the lapping machine and is rotatably driven by servomotor 7. A well known pressure measuring unit 5 is in terconnected between lead nut 3 and servomotor 7 for detecting the pressure value and displaying it on a videodisplay 6.

The apparatus further includes a power supply 8 for driving the shafts of the lapping machine, a proportional integral differential (P.I.D) amplifier indicated at 9 and the central data processing unit 10 controlling the whole apparatus.

Said components are not described in detail as they are the object of another Patent Application of the same Applicant (Italian Patent Application No. 48382A/90 of 16.10.90).

The present invention provides an electronic meter 11 connected to the central data processing unit 10 in which the previously defined K-factor can be set from time to time. Electronic meter 11 receives the signal fed by a probe 15 located on the lower plate 16 and intended to detect the spacing of the latter from the upper plate.

At the end of each machining cycle the thickness of the workpieces located at crossed simmetric positions is detected by a feeler pin 14 which feeds the detected thickness signals to the electronic comparator 12 provided with a display showing the detected thicknesses.

Electronic comparator 12 outputs in turn a signal to microprocessor 13 which makes the average of the heights of the four measured workpieces and feed it to electronic meter 11 where K-factor F(K) is set as described above.

Meter 11 transmits the corrected value F(K) + F(R) to the data processing unit 10 causing the upper plate to be shifted until the corrected thickness of the workpieces to be lapped has been reached as detected by probe 15.

In other words meter 11 effects a comparison among setting data, the measured spacing between the two plates, and the actual thickness of the lapped workpieces so that the central data processing unit 10 is automatically reset by the corrected data.

The present invention has been illustrated and described according to a preferred embodiment thereof, however, it should be understood that operative and/or constructive modifications may be made by those skilled in the art without departing from the scope of the present industrial invention.

Claims

1. A method for the post-process check of the work-

pieces lapped in a double-plate lapping machine characterized in that it includes the steps of measuring at the end of any machining cycle the thickness of the lapped workpieces and comparing it with the setting value F(K) of the machine stored in an electronic meter so that said setting value may be corrected at any machining cycle, thus resetting in the following cycle the setting data stored in a central data processing unit causing the upper plate to be lowered and controlling the pressure applied by said plate.

2. The method of claim 1, characterized in that said central data processing unit is connected to said electronic meter receiving the signal of a probe carried by the lower plate and intended to exactly detect the spacing from the upper plate.

3. The method of claims 1 and 2, characterized in that the check of the thickness of the lapped workpieces is carried out by a feeler pin engaging four workpieces located at crossed simmetric positions.

4. The method of claims 1 to 3, characterized in that said feeler pin is connected to an electronic comparator provided with a videodisplay showing the detected heights of the workpieces and operatively connected to a microprocessor which provides the average of the measured heights and feeds it to said electronic meter.

5. The method of claims 1 to 4, characterized in that said microprocessor is provided with a printer for management statistics and histograms.

6. The method of claims 1 to 5, characterized in that said electronic meter compares the setting values with the signals from the probe of the lower plate and from the feeler pin of the lapped workpieces so as to reset the central data processing unit with the new detected data.

7. An apparatus for carrying out the method of claims 1 to 6, characterized in that it includes means for measuring the pressure of the upper plate, a probe associated to the lower plate and having the function of detecting the spacing from the upper plate, a feeler pin intended to measure the thickness of the lapped workpieces at the end of each machining cycle, a comparator and a microprocessor associated to a central data processing unit controlling the operation of the lapping machine according to the detected data from the probe and the feeler pin.

8. The apparatus of claim 7, characterized in that said feeler pin measures the thicknesses of four lapped workpieces located at diametrally opposed positions and feeds the detected data to said comparator provided with a videodisplay and associated to a microprocessor which provides the average of the four measured thicknesses and feeds it to an electronic meter in which the new setting data F(K) is set.

9. The apparatus of claims 7 and 8, characterized in that said meter is operatively connected to the central data processing unit causing the upper plate to be shifted until the optimum setting data has been detected by said probe.

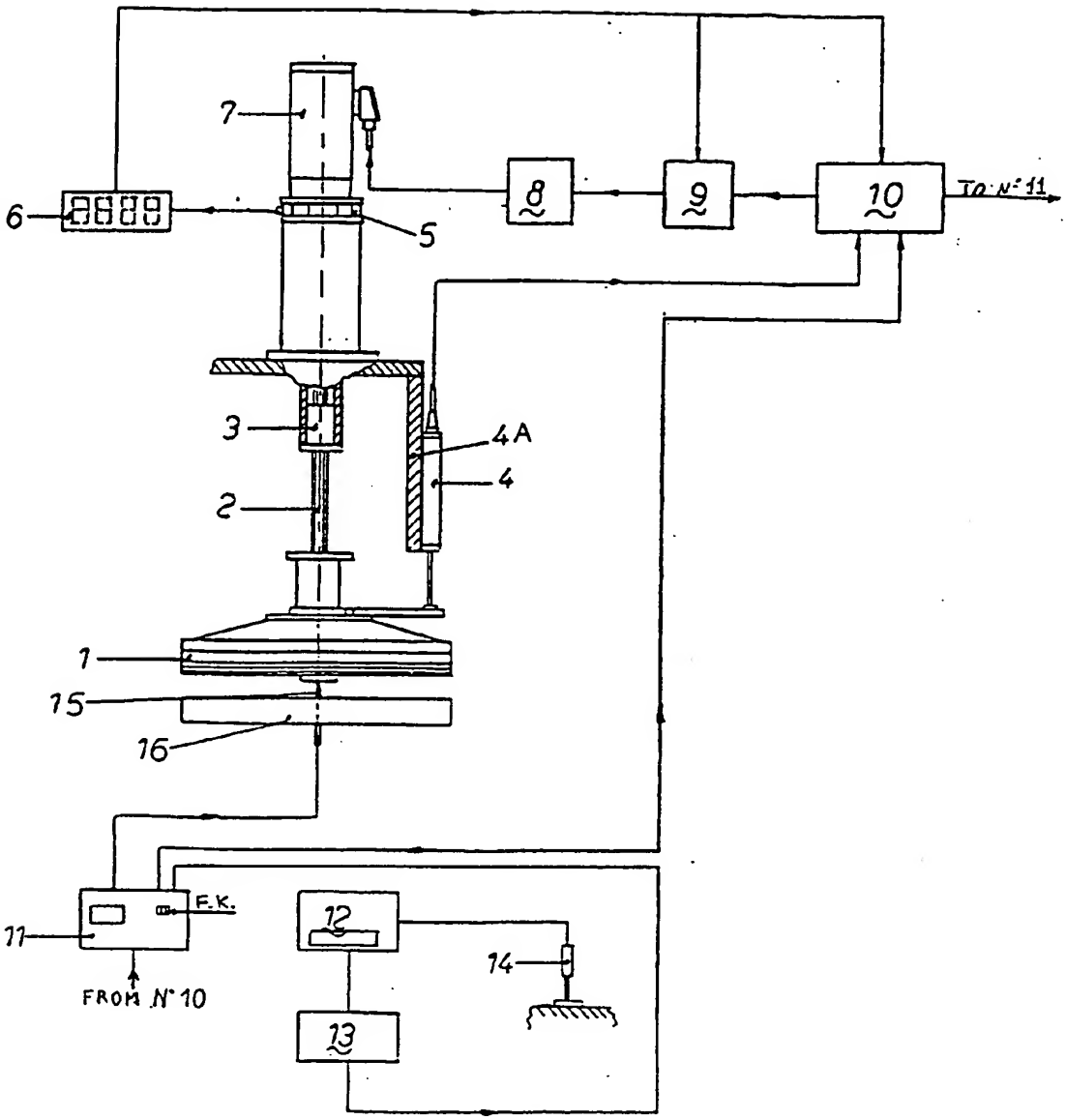

Fig. 1